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Noteworthy anatomical and physiological researches.

Root-tubercles on *Ailanthus*.¹

The tumors upon roots of phanerogams have been studied extensively during the last decade. To the list of plants known to possess root-tubercles we can now add *Ailanthus*. Upon the roots of a tree of *A. glandulosa* cultivated in the botanical garden of Erlangen, Ernst Andreæ discovered numerous tubercles. These tubercles were outgrowths of very irregular shapes, varying from 5 to 40^{mm} in diameter and were most frequently grown together in clumps of three or more. The surface of the tubercles was scabrous, almost warty. One root showed a peculiar development of not only a number of these tubercles, but also an innumerable mass of lateral roots, all of which were of the same thickness and approximately of the same age. These roots were tangled up and more or less grown together, reminding one of some coarse fungus mycelium.

Two questions arise in regard to the origin of the tubercles: are they due to parasitic organisms, or merely to mechanical influences, disturbances in the functions of nutrition, etc.? The author bases his reply to these questions upon the results of a very careful anatomical study of the roots and the tubercles.

He describes minutely the structure of the various forms of tubercles. An old tubercle shows distinctly the original structure of the root, although the deformation is often so great that longitudinal and transverse sections are almost alike. This is seemingly due to the fact that the growing-points of new roots and root-shoots develop in almost any direction, and so the tubercle obtains its roundish shape. Most of these rudimentary roots and shoots do not develop any further. Sometimes, however, they grow so as to form lateral tubercles, but most often they constitute the warty mass which characterizes the surface of the tubercles.

Some fungi were observed by an examination of the structure of the tubercles. They were supposed to belong to the

¹Ernst Andreæ: Ueber abnorme Wurzelanschwellungen bei *Ailanthus glandulosa*. Inaug. diss. Erlangen 1894.

Pyrenomycetes, but they were found in a very imperfect condition. Their occurrence was always merely local; they did not penetrate the entire tubercle, and the mycelium seemed constantly to decrease in size towards the center of the tubercle. Another fact observed was that the fungi only occurred in degenerated or decayed parts of the roots and tubercles. From this fact we might conclude that the fungi were saprophytic in nature, and had nothing to do with the malformation of the roots.

Comparing these tubercles with similar ones on the roots of other plants, the author considers them to be nearly identical with those which Brunchorst described from *Cratægus prunifolia*.² The cause of their formation may be sought in purely external conditions, such as a sudden change in the nutrition of the plant or in some mechanical obstruction. In the present case it was found that the development of the tubercles was especially frequent whenever the roots struck sterile layers of sand, and they were thus at once deprived of their usual nourishment.—THEO. HOLM.

Studies upon galls.³

Pliny was the first to use the word gall (*galla*) as a name for these well-known outgrowths upon plants. The word has since been used for any pathological formation which appears as a thickening or swelling, and which is caused by insects, spiders, or fungi. The injury may, however, be of quite a varied character, and botanical terminology gives a large number of terms for distinguishing between the various forms, under which parasitism or pseudo-parasitism may occur.

Vuillemin⁴ for instance has proposed the terms 'antibiosis' and 'symbiosis,' according as the interference is or is not injurious to the host. But while this writer considers parasitism as intermediate between anti- and sym-biosis, Sarauw⁵ uses parasitism as embracing all the various forms of anti- and sym-biosis.

The result of an antibiosis is probably always the develop-

²Brunchorst: Ueber einige Wurzelschwellungen insbesondere bei *Alnus* und den *Elæagnaceen*. Untersuch. im bot. Inst. Tübingen 1885-88.

³Küstenmacher, Max: Beiträge zur Kenntniss der Gallenbildungen mit Berücksichtigung des Gerbstoffes. Pringsheim's Jahrb. f. wiss. Bot. **26**: —. 1894.

⁴Vuillemin, Paul: Antibiose et symbiose. Assoc. française pour l'avanc. des sciences. **18**: —. 1889.

⁵Sarauw, Georg F. L.: Rodsymbiose og Mykorrhizer. Bot. Tidsskrift. **18**: —. 1893.